JOURNAL OF THE EXPERIMENTAL ANALYSIS OF BEHAVIOR VOLUME 9, NUMBER 4 JULY, 1966

PUNISHMENT AS A DISCRIMINATIVE STIMULUS AND CONDITIONED REINFORCER WITH HUMANS[1]

T. AYLLON AND N. H. AZRIN

ANNA STATE HOSPITAL

Mental hospital patients were reinforced for responding in a two-response operant situation. When a noise was used to punish one of the responses, all subjects shifted to the unpunished one. When the noise was then paired with positive reinforcement, the subjects responded to produce the noise. Also, a novel response was reinforced by noise in the absence of other reinforcers. This study with humans extends the findings of previous studies with animals in revealing how a punishing stimulus can acquire discriminative or conditioned reinforcing properties.

An aversive stimulus will suppress responding when it is delivered as a punisher, *i.e.*, when responding produces it (Skinner, 1938; Estes, 1944; Azrin, 1960; Holz, Azrin, and Ayllon, 1963). The same stimulus seems to have an opposite effect on responding after it has been paired with a positive reinforcer. For example, Holz and Azrin (1961, 1962) found that a punisher could be used to maintain responses by giving it discriminative (cue) or conditioned reinforcing properties. Two conditions must be satisfied before concluding that a stimulus is no longer aversive and can maintain responding. First, it is necessary to obtain independent evidence, preferably with the same subject, that the stimulus will suppress responding when used as a punisher. This step is critical since many stimuli which seem to be aversive do not actually suppress behavior (see review by Azrin and Holz, 1965). Secondly, it must be demonstrated that the punisher has acquired discriminative conditioned reinforcing properties after pairing it with the reinforcer.

In two recent experiments (Holz and Azrin, 1961, 1962), evidence was first obtained that a shock would suppress responses of pigeons before being paired with food reinforcement. After food and shock had been paired, a higher response rate occurred when responding produced the shock than when it did not. These results showed that punished responses could be maintained because of rather than in spite of the delivery of a punisher. Does this phenomenon also occur for human behavior? One study (Azrin, 1958), using normal human subjects, showed that a punishing noise could become a signal, or discriminative stimulus, for delivery of a reinforcer. Whenever the noise occurred, response rate increased. The present experiment used human subjects to ascertain if a punishing stimulus could be given conditioned reinforcing properties in addition to its discriminative ones. The design included a control procedure that was absent in the Azrin (1958) study: an independent estimate of the punishing properties of a noise was obtained before its pairing with a positive reinforcer. After the noise had been paired with the reinforcer, an attempt was made to determine whether the subjects would respond to produce the noise, and whether the noise could be used to reinforce a new response.

METHOD

Three female mental hospital patients, diagnosed as chronic schizophrenic, were studied. The primary criteria for selection were

[1]The research reported in this paper was supported in part by the Mental Health Fund and the Psychiatric Training and Research Fund of the Illinois Department of Mental Health, and Grant 4926 from the National Institute of Mental Health. The assistance of the staff of the Behavior Research Laboratory and Anna State Hospital was invaluable to the successful completion of this project. Grateful acknowledgment is given to D. F. Hake for his suggestions and critical reading of this report. Reprints may be obtained from T. Ayllon, Behavior Research Laboratory, Anna State Hospital, 1000 North Main Street, Anna, Illinois.

that they be ambulatory and that the hospital records give no indication of a chronic organic disorder that might interrupt participation in the study. None was receiving formal psychotherapy. Two patients were receiving tranquilizer medication; no change in dosage was made during the study. The three patients lived in a ward where they exchanged tokens for a variety of privileges such as the opportunity to select a bedroom, watch television, attend movies, leave the ward, and other reinforcers described in detail elsewhere (Ayllon and Azrin, 1965). At the start of this experiment the three patients had been using these tokens for over six months.

Apparatus

The experimental sessions were conducted in a sound-attenuating 7 by 7 ft room, which contained a wall-mounted vending apparatus, a chair, a cigarette lighter, and an ashtray. Mounted on the vending apparatus were two plungers of the type designed by Lindsley (1956). A response was defined as a pull on the plunger over a distance of 2½ cm by a force exceeding 700 g. Each response produced a distinct click. Reinforcement consisted of a token of the type the patients had been using in their ward. A tone was sounded and the chute was illuminated immediately as the token dispensing mechanism was activated. Recording and programming were instrumented automatically by an apparatus located in another room. Simultaneous responding on both plungers, or rapid alternation between them, delayed delivery of a token for 15 sec. A token could not be obtained on a given plunger within 15 sec after the patient had responded on the other one.

The noise used as the punishing stimulus was produced by a 60 cps buzzer at an intensity of 98 decibels as measured at the place where the patient was seated. The experimenters' subjective evaluation was that the noise was "annoying" but not "painful".

Procedure

Before the first session, an assistant brought the patient to the experimental room, seated her before the apparatus, and gave the following instructions: "Notice that there are two knobs. Each knob pays off; you can pull either knob and you'll get tokens." The sessions were conducted daily, weekends excluded. Each session lasted 45 min or until the patient had received 50 tokens, whichever occurred first. The patients were given a fixed number of tokens at the end of each session for remaining in the experimental room for the prescribed duration. This procedure is similar to that used by Holz *et al.* (1963) and Kaufman (1964).

Table 1 presents an outline of the experimental procedure. During the first eight sessions, every 50th response on either plunger produced tokens (FR 50 schedule). The pa-

Table 1

Outline of Experimental Procedure

	Left Plunger	*Right Plunger*	*Number of Sessions*		
			S-9	S-21	S-30
Tokens	FR 50 Reinforcement	FR 50 Reinforcement	8	8	8
Noise as Punishment	FR 50 Reinf	FR 50 Reinf + FR 1 Noise	8	8	8
	FR 50 Reinf	FR 50 Reinf + FR 1 Noise			
	alternating every 5 min with				
	FR 50 Reinf + FR 1 Noise	FR 50 Reinf	8	8	8
Pairing of Noise with Tokens	Extinction, No Noise	FR 50 Reinf + FR 1 Noise	8	8	6
	Extinction, No Noise	FR 50 Reinf + FR 1 Noise			
	alternating every 5 min with				
	FR 50 Reinf + FR 1 Noise	Extinction, No Noise	8	8	8
Noise as a Conditioned Reinforcer for a New Response	*Left Push-button*	*Right Push-button*			
	No Noise	FR 1 Noise			
	alternating every 5 min with				
	FR 1 Noise	No Noise	1	1	1

tient could divide her responses to the two plungers in any manner. The ratio requirement had been gradually increased from FR 1 during 2-6 sessions of preliminary conditioning not shown in Table 1. During the next eight sessions, responses on both plungers continued to produce tokens for every 50th response; in addition, noise was delivered for each response on the preferred plunger, which was the one on the right for all three patients. Each response on the right plunger produced noise for 2 sec; any response on the right plunger during the noise extended it for 2 sec. During the next eight sessions, noise was alternated between the right and left plungers for 5-min periods throughout each session. For the first 5 min of each session only responses on the right plunger produced noise; responses on the left did not. For the next 5 min, responses on the left plunger produced noise; responses on the right did not. Tokens continued to be delivered for every 50th response on either plunger. To the extent that the noise was a punisher, the patients would

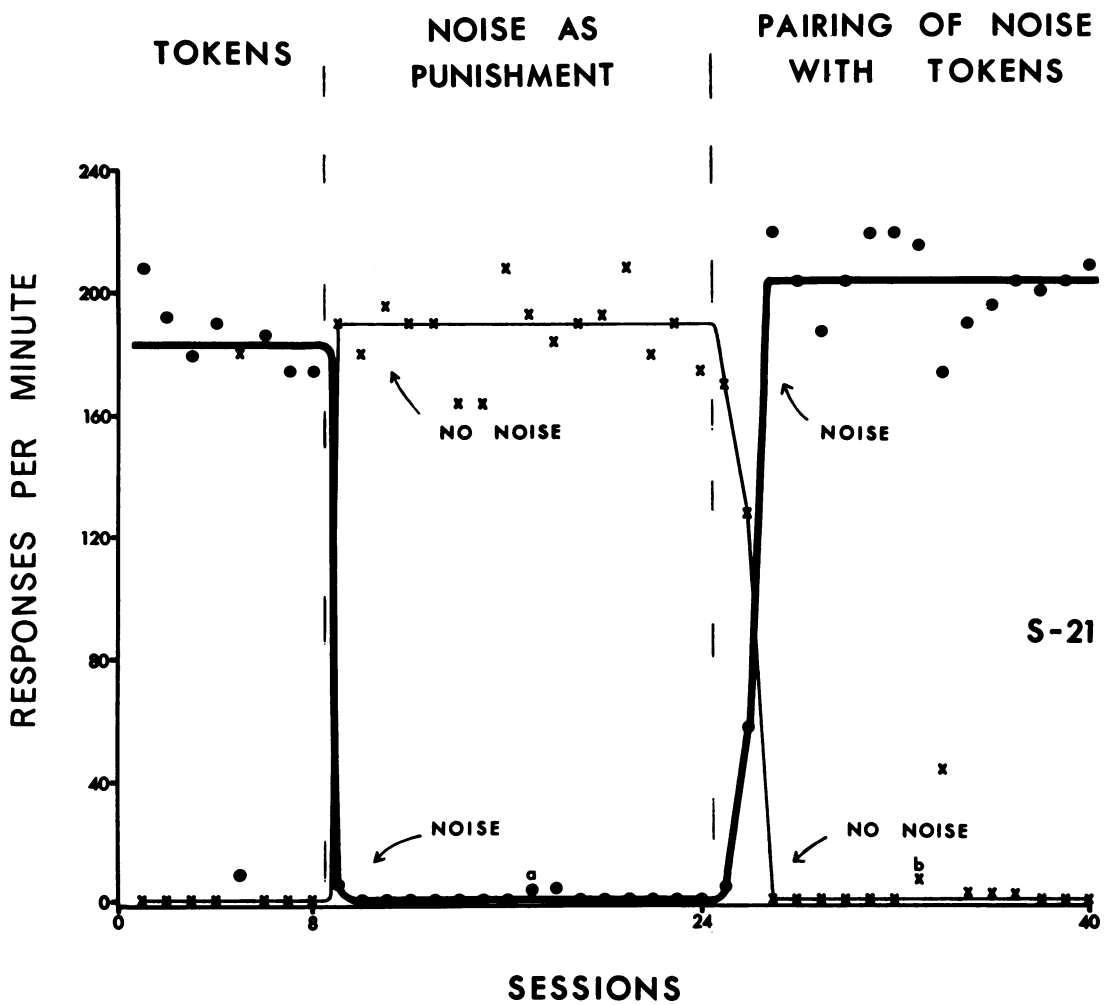

Fig. 1. Rates of knob-pulling responses for one patient, S-21. For sessions 1 through 16, the dots indicate responses to one plunger, and the x's indicate responses to the other. Starting with the ninth session (vertical broken line) noise followed responses on the preferred plunger. From session 17 at "a" through session 24, noise was alternated between the two plungers. For these sessions, the dots represent the rate of the punished responses irrespective of the plunger. Tokens were delivered for every 50th response on either plunger during sessions 1-24. Tokens were exclusively associated with the noise from session 25-40. During sessions 25 through 32, both noise and tokens were scheduled on the originally preferred plunger. From session 33 at "b" through session 40, the noise-token contingency was alternated between the two plungers. Again the dots represent the rate of the responses which produced the noise and tokens, irrespective of the plunger.

be expected to switch to whichever plunger did not produce noise at a given moment.

The tokens were then paired with the noise. For 6-8 sessions, responses on the right plunger produced both noise and tokens; responses on the left produced neither. For the next eight sessions, one plunger at a time produced both noise and tokens in alternating 5-min periods throughout each session. During the final session, two push-buttons were made available while the plungers were locked in place and thus rendered inoperative. The push-buttons were mounted 12 in. below the plungers. Tokens were not delivered during this session. For the first 5 min, responses on the right button produced noise; responses on the left did not. During the next 5 min, responses on the left button produced noise; responses on the right did not. These contingencies alternated in 5-min periods throughout the session. To the extent that the noise had acquired conditioned reinforcing or discriminative characteristics, the patients would respond on whichever button produced the noise.

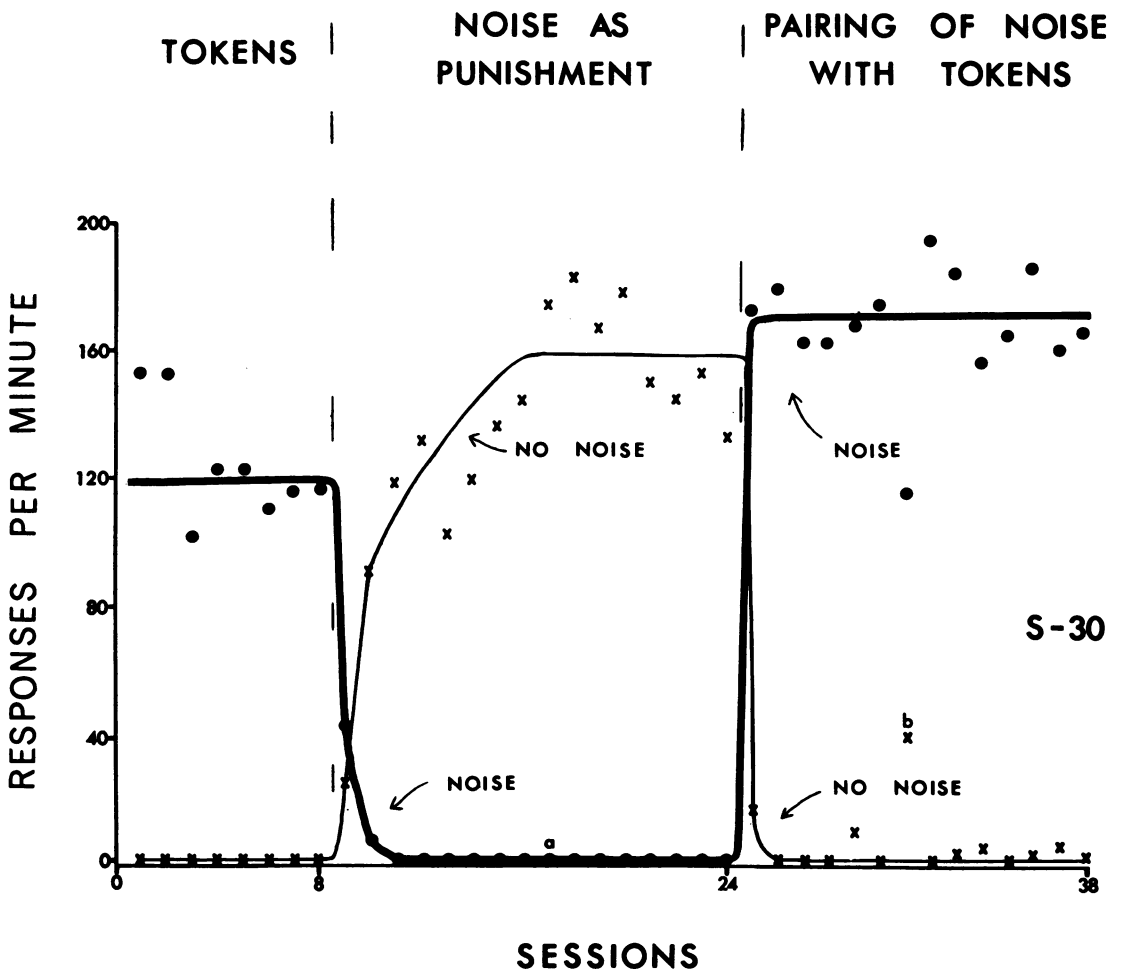

Fig. 2. Response rates for one patient, S-30. For sessions 1 through 16, the dots indicate the response rate on one plunger, and the x's indicate the rate on the other. Starting with the ninth session (vertical broken line) noise followed responses on the preferred plunger. From session 17 at "a" through session 24, noise was alternated between the two plungers. For these sessions, the dots represent the rate of the punished responses irrespective of the plunger. Tokens were delivered for every 50th response on either plunger during sessions 1-24. During sessions 25 through 30 both noise and tokens were scheduled on the originally preferred plunger. From session 31 at "b" through session 38, the noise-token contingency was alternated between the two plungers. Again the dots represent the rate of the responses which produced noise and tokens, irrespective of the plunger.

RESULTS

Figure 1 shows the daily rate of plunger-pulling for one of the patients. During the first eight sessions, a decided preference existed for one of the plungers when responses on both were reinforced. Delivery of noise for responses on the preferred plunger, from sessions 9-16, suppressed punished responses to a near-zero level. Suppression of punished responses continued through sessions 17-24 during which the noise contingency was alternating between the two plungers.

When noise and tokens were paired, for sessions 25-40, the patient responded at a high rate on the plunger that produced them, and rarely responded on the other plunger. The patient continued to respond on whichever plunger produced the paired noise and tokens even when the noise-token contingency alternated between the two plungers, during sessions 33-40. Most of the responses made on the plunger that did not produce the noise and tokens occurred when the alternating schedule was first introduced, at point *b*.

Results for the other two patients are shown in Fig. 2 and 3 and resemble those in Fig. 1. Each patient had an average rate of more than 100 responses per min during the first eight sessions when neither plunger produced noise;

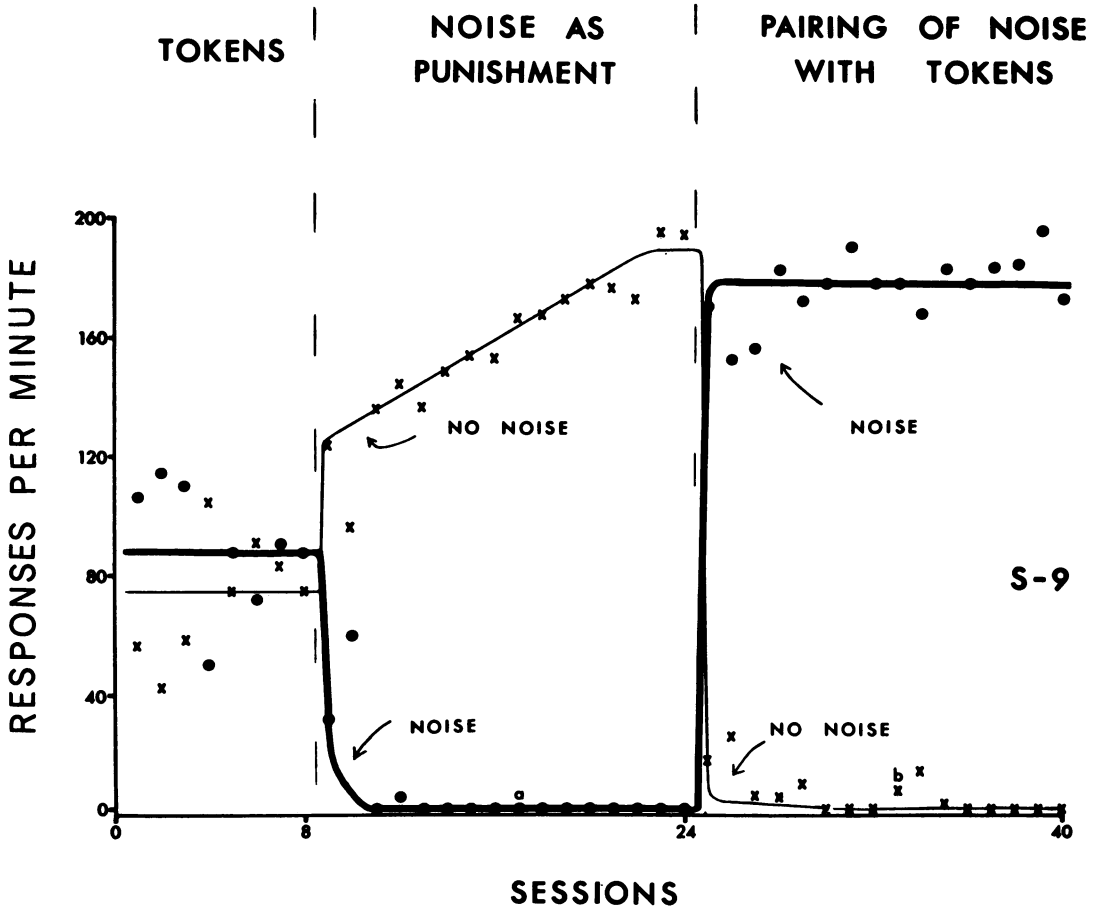

Fig. 3. Response rates for one patient, S-9. For sessions 1 through 16, the dots indicate the response rate on one plunger, and the x's indicate the rate on the other. Starting with the ninth session (vertical broken line) noise followed responses on the preferred plunger. From session 17 at "a" through session 24, noise was alternated between the two plungers. For these sessions, the dots represent the rate of the punished responses irrespective of the plunger. Tokens were delivered for every 50th response on either plunger during sessions 1-24. During sessions 25 through 32, both noise and tokens were scheduled on the originally preferred plunger. From session 33 at "b" through session 40, the noise-token contingency was alternated between the two plungers. Again the dots represent the rate of the responses which produced noise and tokens, irrespective of the plunger.

each had a preference for the right plunger. When noise was introduced, all three patients stopped responding on the plunger that produced noise. Conversely, all three patients responded almost exclusively on the plunger that produced noise when it was paired with tokens.

The suppressive effects of the noise are shown in detail in Fig. 4 which presents continuous response records of one patient for an entire session when the noise contingency alternated between the two plungers. When the noise contingency was changed, at the moment indicated by the oblique lines on the response record, the patient responded for less than 2 sec on the punished plunger, then immediately switched to the unpunished one. This reversal of responding occurred each time the noise contingency was reversed. All three patients showed this rapid and complete suppression of whichever response produced the noise. The number of responses to the punished plunger averaged less than 1% of the number to the unpunished one for each patient on each of the last six sessions under this procedure.

Figure 5 is a continuous record of the responses for one patient for an entire session and shows the temporal pattern of responding when noise was paired with tokens. At the start of the session, the patient made two responses on the left plunger on which neither noise nor token reinforcement were scheduled (these two responses are not discernible from the reproduction of the record). The patient immediately switched to the right plunger and made about 800 responses, each of which produced the noise and every 50th response produced a token. At the end of 5 min, the noise-token contingency was changed to the left plunger. The patient made only six responses on the right plunger, which now produced no noise, then immediately switched to the left, again producing noise and tokens. At the end of the second 5-min period, the patient again made only a few responses before switching to the right plunger which was now producing noise and tokens. The results for all three patients were similar: they stopped responding almost immediately on a given plunger when it ceased to produce noise. The median number of responses per changeover was 2, 3, and 6 for each patient, respectively, during the last six days under this procedure.

Figure 6 shows continuous records of the button pressing responses for each of the three patients during the final session. Each patient made more than 3000 responses on the buttons, over 80 per cent of which were made on the button that produced noise at a given time. The noise contingency alternated be-

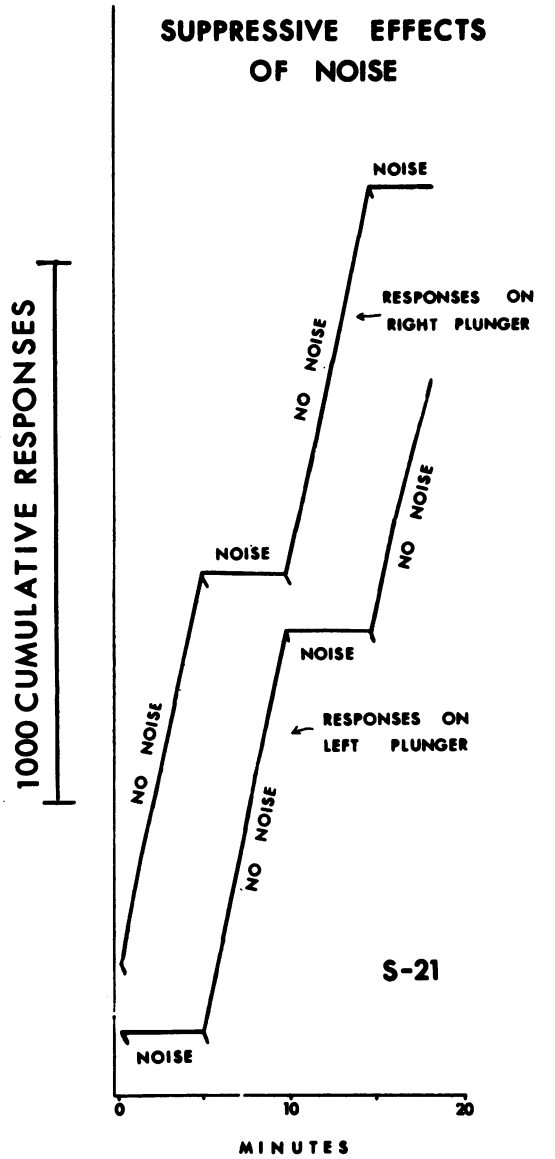

Fig. 4. Performance of one patient, S-21, for an entire session (session 18). Responses on each plunger were recorded concurrently by two cumulative recorders. The top curve shows response rate on the right plunger and the bottom curve response rate on the left plunger. The noise contingency alternated between right and left plungers every 5 min. These shifts are designated by pips on the record.

tween the two buttons every 5 min, at the moment indicated by the oblique marks on the cumulative response curves. During the first 5 min, patients responded on both buttons, but the majority of responses were made on that button which produced the noise.

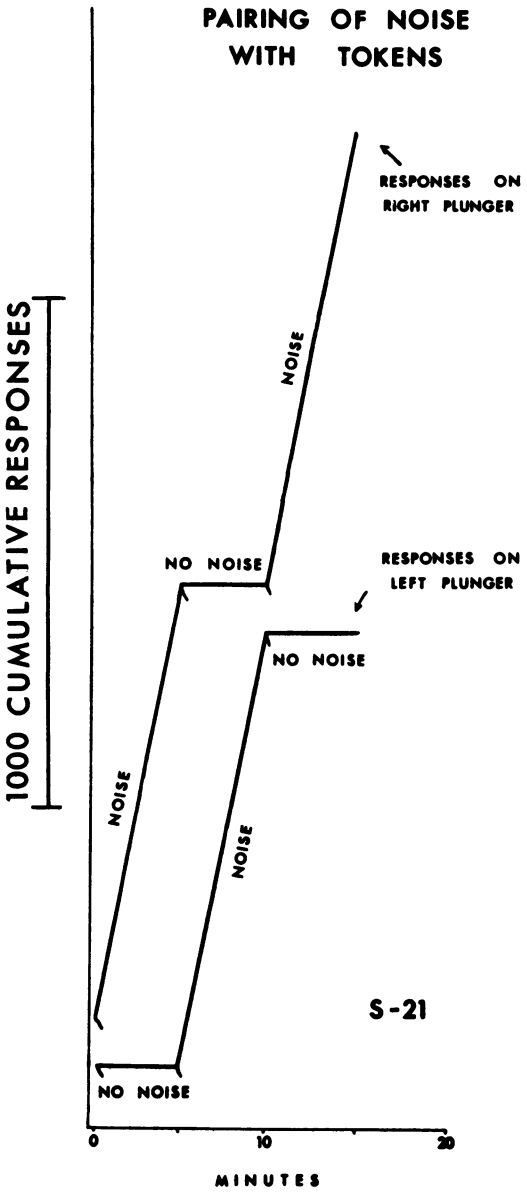

Fig. 5. Performance of one patient, S-21, for an entire session (session 40). Responses on each plunger were recorded concurrently by two cumulative recorders. The top curve shows response rate on the right plunger and the bottom curve response rate on the left plunger. The noise-token contingency was alternated between right and left plungers every 5 min. These shifts are designated by pips on the record.

After 10 min, each patient made fewer than seven responses per min on the button that did not produce noise, but over 90 per min on the one that did. This difference resulted from the patients switching over to whichever button produced the noise. One patient (S-21) stopped responding completely after 17 min and left the experimental room; a second patient (S-9) stopped after 35 min.

DISCUSSION

Evidence for the punishing properties of the noise was (1) the suppression of responses on the initially preferred plunger and (2) the switching of responding to whichever plunger did not produce noise. Evidence of the discriminative or conditioned reinforcing properties of the noise was that all three patients pressed whichever button produced noise, even though the button-presses had never been reinforced. Two patients eventually stopped responding, and the third probably would have if additional sessions had been provided. This temporary maintenance of responding has characterized other studies in which an extinction procedure was used to evaluate the existence of conditioned reinforcement (see review by Kelleher and Gollub, 1962). The present findings extend the generality of similar results with animals which have revealed how a punisher can maintain, rather than suppress, behavior (Holz and Azrin, 1961, 1962).

The procedure which paired tokens with noise provided additional evidence that the noise had become a discriminative stimulus or conditioned reinforcer. At the moment of changeover of the paired noise-token contingency, the patient usually made fewer than six responses on the plunger that did not produce noise before switching to the one that did. The noise had become a discriminative stimulus; it controlled the switching behavior for as long as the pairing procedure was in use.

Previous studies of conditioned reinforcement (see review by Kelleher and Gollub, 1962) and conditioned punishment (Hake and Azrin, 1965) have shown that a stimulus can be given enduring reinforcing or punishing properties by intermittent pairing with an unconditioned stimulus. The present procedure achieved enduring maintenance of the

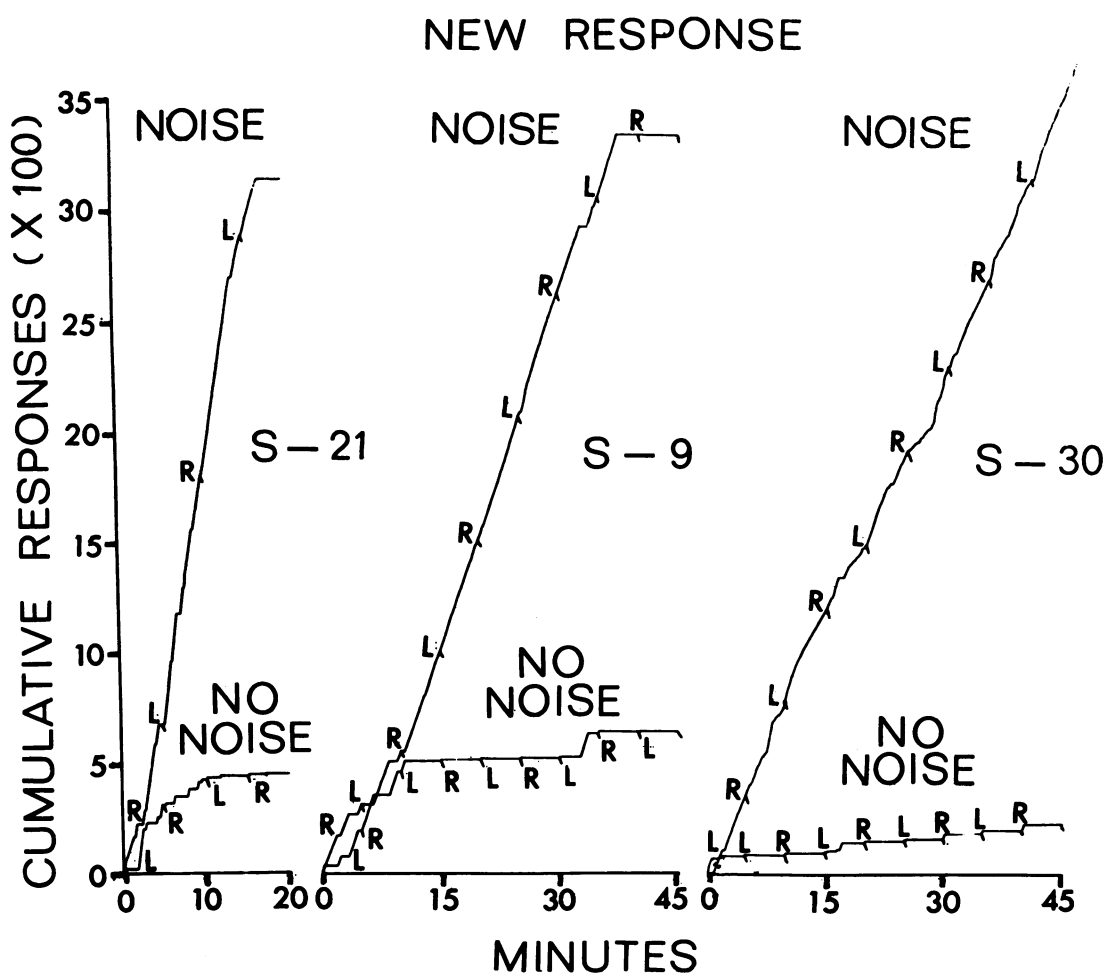

Fig. 6. Performance of the three patients for the entire session when the noise was used to reinforce a new response on two push-buttons. The top curve shows the rate of responses which produced the noise, irrespective of the button. The bottom curve shows the rate of responses which did not produce the noise. No token reinforcement was scheduled for either button. The noise contingency alternated every 5 min between the right (R) and the left (L) buttons. Pips on the record indicate these shifts.

"punished" behavior by intermittently pairing the reinforcer with the "punisher". Only one of 50 punished responses was reinforced by a token. This intermittency may explain how a response can be maintained despite repeated punishment and how it can superficially appear to be independent of positive reinforcement.

It appears that human behavior can be maintained by punishment if the punisher has been given discriminative or conditioned reinforcing properties. These results provide an experimental basis for interpreting clinical phenomena such as "masochism" wherein an individual "seeks out" punishment and does nothing to avoid it.

REFERENCES

Ayllon, T. and Azrin, N. H. The measurement and reinforcement of behavior of psychotics. *J. exp. Anal. Behav.*, 1965, 8, 357-383.

Azrin, N. H. Some effects of noise on human behavior. *J. exp. Anal. Behav.*, 1958, 1, 183-200.

Azrin, N. H. Sequential effects of punishment. *Science*, 1960, 131, 605-606.

Azrin, N. H. and Holz, W. C. Punishment. In W. K. Honig (Ed.), *Operant Behavior and Psychology*. New York: Appleton-Century-Crofts, 1965.

Estes, W. K. An experimental study of punishment. *Psychol. Monogr.*, 1944, 57, No. 3 (Whole No. 263).

Hake, D. F. and Azrin, N. H. Conditioned punishment. *J. exp. Anal. Behav.*, 1965, 8, 279-293.

Holz, W. C. and Azrin, N. H. Discriminative properties of punishment. *J. exp. Anal. Behav.*, 1961, 4, 225-232.

Holz, W. C. and Azrin, N. H. Interactions between the discriminative and aversive properties of punishment. *J. exp. Anal. Behav.*, 1962, **5**, 229-234.

Holz, W. C., Azrin, N. H., and Ayllon, T. Elimination of behavior of mental patients by response-produced extinction. *J. exp. Anal. Behav.*, 1963, **6**, 407-414.

Kaufman, A. E. A procedure for reducing experimental drop-outs. *J. exp. Anal. Behav.*, 1964, **7**, 400.

Kelleher, R. T. and Gollub, L. R. A review of positive conditioned reinforcement. *J. exp. Anal. Behav.*, 1962, Suppl. to Vol. 5, 543-597.

Lindsley, O. R. Operant conditioning methods applied to research in chronic schizophrenia. *Psychiat. Res. Rep.*, 1956, **5**, 118-139.

Skinner, B. F. *The Behavior of Organisms.* New York: Appleton-Century-Crofts, 1938.

Received August 26, 1965